Security paper

This invention relates to a security paper for producing documents of value, such as bank notes, passports, ID cards or the like, which is provided with a coating ensuring longer fitness for circulation, and to a method for producing such a security paper.

Bank notes are usually made of so-called security papers consisting of cotton fibers and having special security features, such as a security thread at least partly worked into the paper, and a watermark. The period of circulation of a bank note depends on the stress it is subjected to. Certain denominations are preferably used in trade and thus have a shorter period of circulation due to the greater impact of environmental influences. The principal cause for the restricted period of circulation of bank notes is deemed to be premature soiling. Since bank note paper is very porous it has a large surface area or high surface roughness. Even if the resulting projections and cavities are in orders of magnitude which cannot be resolved by the human eye, they offer ideal conditions for dirt deposits in comparison with a smooth surface.

AU-PS 488,652 has therefore proposed making bank notes completely from a plastic substrate. However, in this case one must do without customary and proven security elements such as portrait watermarks and window security threads, as well as special properties such as the sound and feel of bank note paper. Also, the steel intaglio printing customary in bank notes, which serves as an additional tactile authenticity mark due to the relief resulting from the inking, merely leads to a flat, hardly perceptible relief on plastic substrates.

The problem of the invention is therefore to produce a security paper which is dirt-repellent and therefore has a long period of circulation and which remains unchanged in its other typical properties, such as printability, sound, color, etc.

The solution to this problem results from the independent claim. Developments are the subject of subclaims.

According to the invention, the security paper is provided at least on one of its surfaces with a coating consisting of a composition containing only a binder and no

fillers. A binder within the meaning of the invention includes all substances which form insoluble films or structures in common solvents. The essential thing is that the binder, unlike customary coating materials, contains no fillers, i.e. pigments such as titanium dioxide, in high concentrations. This composition wets the fibers in the surface area of the paper, forming a complete surface film over the fiber. This minimizes the access of dirt to the fiber.

The composition is applied in a layer thickness so as to form a sufficiently smooth surface and minimize the possibilities of dirt deposit, on the one hand. On the other hand, the layer thickness is so small as not to impair the other properties of the paper, such as its feel and printability. The weight per unit area of the coating is preferably about 1 to 6 g/m^2, in particular 2 to 3 g/m^2.

The small coating thicknesses leave the transmission properties of the paper unchanged so that the recognizability of any portrait watermarks in the security paper is not impaired. The coating additionally has the advantage that one can do without the customary sizing of the paper. The kind of security paper is not subject to any conditions either, so that one can use customary security papers made of annual plant fibers, in particular cotton fibers, as well as security papers consisting at least partly of plastic fibers, preferably polyamide fibers.

The binders used are preferably polyamide lacquers, acrylates or binder systems containing a high percentage of acrylates. If the binder system has several polymer components, they can be present as a mixture or as copolymers. But one can fundamentally use other binder systems as well. Chemically or physically crosslinkable compositions have proved particularly useful.

Particularly acrylate systems have a number of advantages over other binder systems, for example ones based on polyurethane. They thus have better printing properties and contain fundamentally less solvent so that their processing involves lower environmental impact. Acrylate coatings are in addition characterized by higher surface hardness so that the dirt-repellent effect is improved. Finally, acrylate systems offer the advantage of being considerably more cost-effective than other binder systems and being readily mixable with other polymers.

The binder composition is knife-coated or printed on the paper after production of the latter. This can be done directly subsequent to papermaking in the paper machine or in a separate operation, for example directly before printing the security paper. If required, the smoothness of the surface can subsequently be increased by corresponding calendering. The inventively coated paper offers an ideal printing surface for high print resolution and very good ink adhesion in case of attempted physical and/or chemical attacks.

Then the inventive security paper is printed and possibly processed further in accordance with the paper of value to be produced. A print or embossing, in particular if produced by intaglio printing, leads to a rough surface again and therefore favors dirt deposits. In order to exclude this as well, it is proposed according to the invention that the print be covered with a further binder layer, e.g. lacquer layer. The lacquer layer is preferably adjusted in its composition to the inventive background layer to permit a good bond of the two layers. The bond might be improved by an additional crosslinking step. This can be done by the action of heat or irradiation (e.g. UV radiation). Since the print can be produced with any printing process, such as by steel intaglio or with a laser printer, it might be necessary to adapt the inventive binder composition to the printing process used in order to ensure not only low soiling but also improved adhesion of the inks to the substrate.

A further advantage of the invention is that one can do without further pretreatment of the inventive security paper when optically variable security elements are to be provided on the paper. Optically variable devices or inks showing a viewing angle dependent interplay of colors due to diffraction or light interference require a smooth background for good visibility of this effect. Security elements of this kind are for example holograms, kinegrams or other diffraction structures, as well as inks containing interference layer or liquid crystal pigments or other special-effect pigments such as glossy metallic-effect pigments.

In special cases, however, it may still be useful to provide a further background layer in the area of said element. Liquid crystal pigments and interference layer pigments consisting only of thin mica plates coated with titanium dioxide are transparent so that the color effect is not influenced by the smoothness alone but also by the

color of the background. A black background absorbs light transmitted by the pigments, thereby increasing the brilliance of the colors reflected by the pigments. The same applies to security elements constructed of several thin layers and likewise showing an interplay of colors based on interference effects. For these and similar elements it may therefore be necessary to provide the security paper with a further background layer in the area of the security element to be applied.

Alternatively, it may also be expedient to underlay the security element with a ~~mechanically~~ machine detectable or visually detectable authenticity feature, as known for example from WO 97/35732.

The inventive coating furthermore has an advantageous effect on other security elements. For example, it makes embossed structures more trenchant since the smoother background makes the embossings more prominent. Embossings are also more durable since not only the paper fibers are embossed.

According to a preferred embodiment, the coating composition additionally contains a low concentration of at least one substance with a visually and/or ~~mechanically~~ machine detectable physical property. The substance can have for example magnetic, electroconductive, diffractive, light-polarizing or light-interfering properties and be uniformly distributed all over the total coating or applied in the form of patterns. One thereby preferably, in a first step, prints a certain pattern of a composition containing small amounts in the manner of a doping (< 1 wt%) of at least one substance with at least one visually and/or ~~mechanically~~ machine detectable physical property. Only in a second step does one apply the same composition but not containing the detectable additive to the remaining part of the surface of the paper in register with the first pattern.

Said additives can be for example luminescent substances excitable with UV light and emitting in the visible spectral region. In the case of a machine check, however, one can also use luminescent substances emitting in the invisible spectral region, preferably the IR spectral region. One can likewise use photochromic or thermochromic additives.

Instead of physically detectable substances one can also use chemically reacting additives. For example, one can admix a component of a color reaction system to

the binder composition and apply it to the paper. When one applies the second component of the color reaction system at a later time, a colored area, pattern, writing or the like becomes visible on the security paper. This can serve as an authenticity feature or as a cancellation mark for a check, airplane ticket or the like.

By using a plurality of additives and/or varying the concentration of one or more additives one can very simply produce any kind of coding, for example a bar code, on the security paper. Said coding can for example constitute an independent additional security feature or serve as a reference feature for other data already provided on the security paper. Thus, information visible to the naked eye on the bank note, such as denomination, the name of a person shown in the portrait or the like, can be encrypted and stored on the paper in the form of the inventive coding invisible to the naked eye. In a machine check the coding is read, decrypted and tested for identity with the corresponding information visible to the naked eye.

According to the inventive principle one can of course also produce a plurality of different codings. For example, one applies the binder compositions containing the particular additive to the paper in the form of the desired codings simultaneously or successively. One prints or coats the remaining part of the paper surface with additive-free binder composition, as explained above. Alternatively, the different codings can also be disposed on different surfaces of the security paper. Double-sided coating with the same additive is of course likewise possible.

According to a further embodiment, the inventive coating can also have gaps. Said gaps can have any form, e.g. a striped form. Before or after application of the inventive coating they are provided with a print having certain special-effect inks. Said special-effect inks may be interference layer pigments, liquid crystal pigments or other gloss pigments. Said print can cover the gaps all-over or only partly.

The inventive security paper can for example also be used advantageously for producing ID cards and passports. Since it has increased tear strength and dirt resistance, one might possibly do without the customary lamination with plastic foils. If lamination is nevertheless effected, the inventive coating ensures a firm, inseparable bond between paper and cover layer.

In the following some examples of the inventive composition will be explained.

Example 1

A bank note paper made of 100% cotton with a filler content of 3.0% is used for the coating test. The paper is adjusted to a wet strength of 50% based on the dry strength by using commercial melamine resin (e.g. Madurit MW167).

The following formulation is used as the coating:

Acronal 320D (BASF) - aqueous dispersion of acrylic resin -	400 ml
Softened water	600 ml

The mixture is prepared by stirring and applied to the surface of the paper. For this purpose one uses a rotating pair of rolls whose lower side dips into a dish with the diluted Acronal dispersion. Excess suspension is pressed off through the roll slit. The paper is subsequently dried with a commercial photo drier.

The treatment gives the paper the following properties:

Properties	Before treatment	After treatment
Air permeability	25 ml/min	5 ml/min
Water absorption 60 sec	50 g/m²	20 g/m²
Oil absorption GFL	30 sec	150 sec

Example 2

A paper is coated in the same way as stated in Example 1 with the following formulation:

Neocryl-AC 72 (Zeneca) - aqueous dispersion of acrylate -	900 ml
Water	80 ml

Crosslinker CX 100 (Zeneca)	20 ml

Example 3

The paper can also be coated with the following binder composition:

Primal 1-545 (Rohm & Haas) - aqueous dispersion of acrylate -	900 ml
Water	80 ml
Zirconium carbonate (Auer Remy)	20 ml

Example 4

The inventive binder system can also consist of a mixture of several polymers. As an example the following formulation is stated:

Glascol LS 26 (Ciba) - aqueous dispersion of acrylate-styrene copolymer -	700 ml
Polyurethane U 400 N (Alberdink Boley)	200 ml
Water	100 ml

Further advantages and embodiments will be explained in more detail with reference to the figures. It is pointed out that the figures show the layer structure of the inventive security paper only schematically.

Fig. 1 shows an inventive security paper from the front,

Fig. 2 shows a section along A - B through the inventive security paper according to Fig. 1,

Fig. 3 shows a further embodiment of an inventive security paper from the front,

Fig. 4 shows a cross section along A - B through the inventive security paper according to Fig. 3.

Fig. 1 shows a detail of inventive security paper web 1 as is used for example for producing bank notes. Such security paper is usually made of cotton fibers or other annual plant fibers. For some applications, however, it may be useful to replace part of said natural fibers by plastic fibers, in particular polyamide fibers. Pure plastic fiber papers are also possible. During production of paper web 1 individual security elements are already embedded in the paper, such as a portrait watermark or security thread 2 shown in Fig. 1. Security thread 2 is quasi woven into the paper so as to pass directly to the surface of the paper in areas 3 while being embedded completely in paper pulp in the dash-lined areas. Thread 2 can be provided with any desired security features, such as an electroconductive, metallic layer, hologram or the like.

Fig. 2 shows a section through inventive security paper 1 along dash-dotted line A - B in Fig. 1. Inventive security paper 1 consists of raw paper 4 as usually leaves the paper machine, and inventive binder coating 5 which was knife-coated or printed all over a surface of security paper 1 according to the shown embodiment. Alternatively, coating 5 can also be applied to security paper 1 on both sides.

Figs. 3 and 4 show a further embodiment of inventive security paper 1. Fig. 4 shows a section through inventive security paper 1 along dash-dotted line A - B in Fig. 3.

As shown in Fig. 4, security paper 1 likewise consists of customary paper web 4 provided with a pure binder composition without fillers according to the invention. However, the binder layer is composed of different areas 6, 9. In areas 6 the binder composition is doped with an additive which is testable visually and/or ~~mechanically~~ by machine while remaining areas 9 of the binder composition contain no additive. As evident from Fig. 3, area 6 represented by the doped binder composition forms visually readable information. Areas 7 likewise represented with the doped binder composition form coding 8 in the form of a bar code.

The additive may be for example a luminescent substance transparent in normal illumination but emitting in the visible spectral region and thus showing an intensive tone when irradiated with UV light. In this case information 6, 8, as shown in Fig. 3, is visible only in UV illumination.

However, one can also provide a plurality of additives which are singly detectable. The mixture ratio of the additives can be used to produce an additional coding. It is likewise conceivable to produce information 6, 8 with different additives. Thus, one can produce information 6 with the aid of a luminescent substance emitting in the visible spectral region, as explained above, while representing bar code 8 with the aid of a substance detectable solely by machine, e.g. a luminescent substance emitting in the IR spectral region. Marks 6 visible to the naked eye in UV illumination can represent for example a picture, pattern or readable information. Machine-readable code 8, however, could represent certain information characteristic of the individual document of value, optionally in encrypted form. Said information could be properties inherent to the paper material, such as transmission properties, thickness distribution, etc., or other information essential to the particular document of value, such as denomination or the like.